CHAPTER 6 EXISTING INSTALLATIONS: POWER BOILERS

600 MAXIMUM ALLOWABLE WORKING PRESSURE

600.1 The maximum allowable working pressure on the shell or drum of a power boiler shall be determined by the strength of the weakest section of the structure, computed from the following information:

(a) The thickness of the plate;

(b) The tensile strength of the plate;

(c) The efficiency of the longitudinal joint, or tube ligaments (whichever is least);

(d) The inside diameter of the course; and

(e) The factor of safety allowed by this chapter.

600.2 The maximum allowable working pressure computation shall be as follows:

$$\frac{TS \times t \times E}{R \times FS} = \text{maximum allowable working pressure in pounds per square inch}$$

where

TS = ultimate tensile strength of shell plates, pound per square inch.
t = minimum thickness of shell plate in weakest course in inches
E = efficiency of longitudinal joint.
R = inside radius of the weakest course of the shell or drum in inches.
FS = factor of safety allowed by these rules.

601 FACTORS OF SAFETY

601.1 The factor of safety for boilers of nonstandard construction, the longitudinal joints of which are of butt and double strap construction, shall be not less than the following:

(a) 4.5 for boilers not over 20 years old;

(b) 5 for boilers over 20 and not more than 25 years old;

(c) 5.5 for boilers over 25 and not more than 30 years old;

601.2 At the beginning of each five (5) year period thereafter, the factor of safety shall be increased by not less than five-tenths (0.5).

601.3 In no case shall the maximum allowable working pressure on old boilers be increased unless they are being operated at a lesser pressure than would be allowable for new boilers, in which case the changed pressure shall not exceed that allowable for new boilers of the same construction.

601.4 The factor of safety for all standard boilers, the longitudinal joints of which are of butt and double strap construction shall be 5 for boilers not more than twenty-five (25) years old, and at the beginning of each five (5) year period thereafter, the factor of safety shall be increased by not less than five-tenths (0.5); Provided, that after a thorough internal and external inspection and a hydrostatic pressure test to one and one-half times the pressure allowed during which no distress or leakage develops, the pressure allowed may be continued at a factor of safety of 5.

601.5 The lowest factor of safety for boilers of the water-tube type of nonstandard construction, the longitudinal joints of which are of lap riveted construction shall be not less than the following:

(a) 5 for boilers not over 20 years old.

(b) 5.5 for boilers over 20 and not over 25 years old.

(c) 6 for boilers over 25 and not over 30 years old.

601.6 At the beginning of each five (5) year period thereafter, the factor of safety for boilers of the water-tube type of nonstandard construction, the longitudinal joints of which are of lap riveted construction, shall be increased by not less than five-tenths (0.5).

601.7 The lowest factor of safety for all fire tube, flue and cylinder boilers on nonstandard construction, the longitudinal joints of which are of lap-riveted consideration, except as provided for in §601.5, shall be not less than the following:

(a) 5 for boilers not over 10 years old.

(b) 5.5 for boilers over 10 and not over 15 years old.

(c) 5.75 for boilers over 15 and not over 20 years old.

(d) 6 for boilers over 20 years old.

601.8 At the beginning of each five (5) year period thereafter, the factor of safety for boilers as described in §601.7 shall be increased by not less than five-tenths (0.5).

601.9 The lowest factor of safety for all fire tube, flue and cylinder boilers of nonstandard construcion, the shells of which are exposed to the products of combustion and which have continous longitudinal joints of lap-riveted construction exceeding twelve feet (12') in length, shall be not less than the following:

(a) 6 for boilers not over 10 years old.

(b) 6.5 for boilers over 10 and not over 15 years old.

(c) 7 for boilers over 15 and not over 20 years old.

601.10 At the beginning of each 5-year period thereafter, the factor of safety for boilers as described in §601.9 shall be increased by not less than five-tenths (0.5). This type of boiler when removed from an exisitng setting shall not be reinstalled for a pressure in excess of fifteen (15) pounds.

602 CAST-IRON HEADERS AND MUD DRUMS

602.1 The maximum allowable working pressure on water-tube boilers, the tubes of which are secured to cast-iron or malleable-iron headers, or which have cast-iron mud drums, shall not exceed one hundred sixty (160) pounds per square inch.

603 TENSILE STRENGTH

603.1 When the tensile strength of steel or wrought iron shell plates is not known, it shall be taken as fifty-five thousand (55,000) pounds per square inch for steel and forty-five thousand (45,000) pounds per square inch for wrought iron.

604 CRUSHING STRENGTH OF MILD STEEL

604.1 The resistance to crushing of mild steel shall be taken at ninety-five thousand (95,000) pounds per square inch of cross-sectional area.

605 RIVETS

605.1 In computing the ultimate strength of rivets in shear the cross-sectional area of the rivet shank shall be used for the values in pounds per square inch based upon the requirements of paragraphs P-16 of the A.S.M.E. Code.

605.2 When the diameter of the rivet holes in the longitudinal joints on a boiler is not known, the diameter and cross-sectional area of rivets, after driving, may be selected from Table 6-1 or ascertained by cutting out one rivet in the body of the joint.

606 INSPECTION OF INACCESSIBLE PARTS

606.1 The heads of water tube boiler mud drums or headers which are not accessible for inspection shall have the brick work removed after the boiler has been in service for ten (10) years and at not less than every five (5) years period thereafter.

606.2 All seams and parts of fire-tube boilers that are not accessible for inspection shall be exposed whenever in the discretion of the inspector the general condition of the boiler appears to be such that further examination is desirable.

607 SAFETY VALVES

607.1 Each boiler shall be equipped with one or more safety valves of the spring-pop type with a lifting device, placed as close to the boiler as possible. No valve of any description shall be placed between the safety valve and the boiler nor on the escape pipe between the safety valve and the atmosphere. When an elbow is placed on a safety valve escape pipe, it shall be located close to the safety valve outlet or the escape pipe shall be securely anchored and supported. When an escape pipe is used, it shall be full sized and fitted with an open drain to prevent water lodging in the upper part of the safety valve or escape pipe. Safety valve having either the seat or disk of cast iron shall not be used. Dead weight and lever weight safety valves shall be prohibited.

607 SAFETY VALVES (Continued)

607.2 The safety-valve capacity of each boiler shall be such that the safety valve or valves will discharge all the steam that can be generated by the boiler without allowing the pressure to rise more than six percent (6%) above the maximum allowable working pressure, or more than six percent (6%) percent above the highest pressure to which any valve is set.

607.3 One or more safety valves on every boiler shall be set at or below the maximum allowable working pressure. The remaining valves may be set within a range of three percent (3%) above the maximum allowable working pressure, but the range of setting of all the safety valves on a boiler shall not exceed ten percent (10%) of the highest pressures to which any valve is set.

§§608 - 610 RESERVED

611 PARTS AND EQUIPMENT FOR EXISTING INSTALLATIONS: POWER BOILERS

611.1 Fire-actuated fusible plugs when used shall conform to the rules and regulations of the A.S.M.E. Code for new construction.

611.2 Each steam boiler shall have at least one water glass, the lowest visible part of which shall be as called for under the A.S.M.E. Code for new construction.

611.3 Each boiler shall have three or more gage cocks located within the range of the visible length of the water glass when the maximum allowable working pressure exceeds fifteen (15) pounds per square inch except when such boiler has two water glasses with independent connections to the boiler, located on the same horizontal line and not less than two feet (2') feet apart.

611.4 No outlet connections except for damper regulator, feed water regulator, low water fuel cut-out, drains or steam gage shall be placed on the pipes connecting a water column to a boiler. Each water column shall have a valved drain run to within six inches (6") of the floor.

611.5 Each steam boiler shall have a steam gage connected to the steam space or to the steam connection to the water column. The steam gage shall be connected to a siphon or equivalent device of sufficient capacity to keep the gage tube filled with water and so arranged that the gage cannot be shut off from the boiler except by a cock placed near the gage and provided with a T or level handle arranged to be parellel to the pipe in which it is located when the cock is open.

611.6 Each steam boiler when mechnically fired shall be equipped with a low-water cut-off so located as to automatically cut off the fuel supply when the water level falls to a point not lower than the top of the bottom nut of the water glass. Each cut-off shall have a drain run to within six inches (6") of the floor.

611.7 When two or more mechnically fired boilers are connected to the same system, each boiler shall have independent low-water cut-offs, controls, and gages.

611.8 Each steam outlet from a high-pressure boiler (except safety-valve connections) shall be fitted with a stop valve located as close as practicable to the boiler.

611.9 When a stop valve is so located that water can accumulate, free blow drains shall be provided, the discharge of which shall be visible to the operator while manipulating the valve.

612 BLOW-OFF CONNECTION

612.1 Each boiler shall have a full-size blow-off fitted with a valve or cock in direct connection with the lowest water space practicable. When cocks are used they shall be of the gland or guard type and suitable for the pressure allowed. Globe valves are not permitted.

612.2 When the maximum allowable working pressure exceeds one hundred (100) pounds per square inch, the blow-off shall be extra heavy from boiler to valve or valves,and shall run full size without reducers or bushings. Blow-off piping shall be of black wrought iron or black steel (not galvanized) and shall be extra heavy pipe.

612.3 All fittings, between the boiler and valve shall be steel or extra heavy fittings of bronze, brass, or malleable iron. In case of renewal of pipe or fittings in the blow-off lines, as specified in this paragraph, they shall be installed in accordance with the A.S.M.E. Code for new installations.

612.4 When the maximum allowable working pressure exceeds one hundred (100) pounds per square inch, each bottom blow-off pipe shall be fitted with two valves or a valve and cock, such valves and cocks to be of the extra heavy type.

612.5 A bottom blow-off pipe when exposed to direct furnace heat shall be protected by fire-brick or other heat-resisting material, so arranged that the pipe may be inspected.

612.6 An opening in the boiler setting for a blow-off pipe shall be arranged to provide for free expansion and contraction.

613 FEED-WATER CONNECTIONS

613.1 The feed pipe of a steam boiler shall be provided with a check valve near the boiler and a valve or cock between the check valve and the boiler, and when two or more boilers are fed from a common source, there shall also be a globe valve on the branch to each boiler between the check valve and the source of supply. When a globe valve is used on a feed pipe, the inle+ shall be under the disk fr the valve

613.2 In all cases where the safety valve is set above twenty-five (25) pounds, there shall be an additional means of feeding water against the maximum approved pressure.

614 TEST PRESSURE

614.1 When a hydrostatic test is applied, test pressure shall be not more than one and one-half times the maximum allowable working pressure.

614.2 During a hydrostatic test of a boiler, suitable provisions shall be made so that it will not be necessary to screw down the compression screw upon the spring of the safety valve.

615 REPAIRS AND REPLACEMENTS

615.1 Where repairs or replacements are made or fittings or appliances renewed or attached to a boiler, they must comply with the Code for new installations.

616 CONDITIONS NOT COVERED BY THESE RULES

616.1 In any condition not definitely covered by this chapter, the A.S.M.E. Code for new installations shall apply.

TABLE 6-1

SIZES OF RIVETS BASED ON PLATE THICKNESS
(see §605.2)

	Inch	Inch	Inch	Inch	Inch	Inch
Thickness of plate	1/4	9/32	5/16	11/32	3/8	13/32
Diameter of rivet after driving	11/15	11/16	3/4	3/4	13/16	13/16
Thickness of plate	7/16	15/32	1/2	9/16	5/8	-----
Diameter of rivet after driving	15/16	15/16	15/16	11/16	11/16	-----